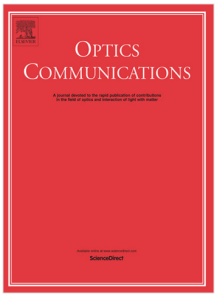
Accepted Manuscript



Compact large size color 3D dynamic holographic display using liquid crystal display panel

Pan He, Juan Liu, Tao Zhao, Yu Han, Yongtian Wang

PII: S0030-4018(18)30787-9
DOI: https://doi.org/10.1016/j.optcom.2018.09.006
Reference: OPTICS 23445

To appear in: *Optics Communications*

Received date : 11 June 2018
Revised date : 29 August 2018
Accepted date : 4 September 2018

Please cite this article as: P. He, et al., Compact large size color 3D dynamic holographic display using liquid crystal display panel, *Optics Communications* (2018), https://doi.org/10.1016/j.optcom.2018.09.006

Optics Communications

Compact large size color 3D dynamic holographic display using liquid crystal display panel

Pan He, Juan Liu*, Tao Zhao, Yu Han, and Yongtian Wang

Beijing Engineering Research Center for Mixed Reality and Advanced Display Technology, Beijing Institute of Technology, Beijing 100081, China

*Corresponding author.

E-mail address: juanliu@bit.edu.cn

Keywords:
Holography
Holographic display
Computer holography

ABSTRACT:

Large three-dimensional (3D) scene reconstruction is a challenge for current colour holographic displays. In this study, we develop a compact display system to reconstruct a large 3D scene using a 21-inch liquid crystal display (LCD) panel that serves as a spatial light modulator (SLM). We utilise a Fresnel lens instead of a conventional lens to reduce the complexity of the system. A spatial multiplexing colour filter attached to the SLM is used to simplify the structure of the colour display. Additionally, an independent block holographic algorithm is developed to record accurate depth information. Numerical simulations and optical experiments are performed to verify the proposed system. The optically reconstructed 3D colour scene is 480 mm × 300 mm × 500 mm in size. Therefore, the proposed display system represents development toward a commercial product for its low device requirements.

1. Introduction

Holographic display has been regarded as the ultimate technique for reconstructing three-dimensional (3D) scenes that provide full parallax and depth information for human eyes. A key element to realising holographic displays is the display system itself, which reconstructs the full light field information of a real 3D scene [1-3]. Generally, the spatial light modulator (SLM) is one of the most important optoelectronic devices for a holographic display system [4,5]. However, the panel size of the SLM is extremely influenced by pixel pitch and pixel count, which limits the size of the 3D scene to several millimetres or centimetres. Although many research groups have done numerous studies to reconstruct large 3D scenes, it is still a challenge to reduce the complexity of the display system.

There are two ways to enlarge the reconstructed 3D scene: (1) the use of spatial-temporal multiplexing techniques, or (2) the use of large size display devices. With spatial-temporal multiplexing techniques, several studies have been done to splice the display devices to reconstruct a larger 3D scene [6-11]. A dynamic 3D holographic display system based on acousto-optic modulators was designed to solve the issue, using a scanning system that consisted of a vertical scanner and a horizontal scanner. The maximal display size of the 3D holographic display system was 150 mm × 75 mm × 150 mm [8,9]. This kind of system requires scanning with high refresh rates, and the horizontal